

HOW IT WORKS

High Definition TV

High Definition televisions promise clearer, sharper and better pictures than ever before. Tom Royal explains the different standards and reveals when you can expect to see HD TV on a screen near you

In this month's *Labs* we've tested 11 large LCD televisions (see page 175). These are ideal if you want a screen that can be used for every purpose; as well as viewing TV and DVDs, you can connect a PC and view video files and photos in glorious widescreen. Better still, every one of them is capable of displaying High Definition video.

Not everyone knows what High Definition is, though, let alone how it works. In this article we'll explain just how much better this new television standard is, how it works and, most important of all, when you'll be able to use it.

STANDARD TV RESOLUTIONS

Most modern computer displays are capable of producing a resolution of at least 1,024x768 pixels, and many can run at resolutions of up to 1,600x1,200. Standard televisions, however, run at a far lower resolution. The PAL I television standard used in the UK has a vertical resolution of 625 horizontal lines, only 576 of which are used for the visible picture.

In order to conserve bandwidth without reducing the frame rate and introducing flickering, the signal is interlaced. The horizontal lines are divided into two sets of alternating lines, one containing the odd-numbered lines and the other the even-numbered lines. Each set is known as a field. Fifty of these alternating fields are displayed every second, effectively displaying only 25 full frames of information.

A similar system is used in the USA. The American NTSC M standard uses a different method for encoding colour information that

requires a tint control on each TV set to correct any colour problems. This has led engineers jokingly to say NTSC stands for as 'Never The Same Colour'. It uses 525 lines, of which 480 are visible, and is interlaced in the same manner as PAL. In NTSC one field is shown every 60th of a second, producing 30 full frames per second (fps). This slightly higher frame rate makes NTSC slightly less susceptible to flicker than PAL.

These techniques work well with traditional CRT-based televisions as they can draw one field and then the other in turn. LCD, projector and plasma displays, however, do not draw alternate lines in this way. When you watch television on your computer, a projector or an LCD or plasma TV, the interlaced picture must be converted into one that can be drawn in one pass rather than two.

This process is known as de-interlacing, and it can sometimes result in errors that are visible as jagged, tooth-like edges and ghosting. The quality of the de-interlaced picture varies from television to television depending on the quality of the processor used to perform the de-interlacing.

BIGGER AND BETTER?

Using a higher resolution than PAL I or NTSC M is not a new idea. After the Second World War, France used a unique 819-line system. This used 755 visible and interlaced lines, but it was discontinued in the 1980s. Japan introduced the MUSE system, which provided 1,035 interlaced lines via an analogue transmitter, in the 1990s. It has since been replaced by a digital system. Over the past few years, three new standards for higher-definition

FURTHER INFORMATION

More information on the HD Ready classification system
www.eicta.org

Information on Sky's forthcoming High Definition television service
<http://hd.sky.com>

Digital cable television providers
www.telewest.co.uk, www.ntl.com

The 720p, 1080i capable Xbox 360 console
www.xbox.com

Some good examples of de-interlacing problems
www.100fps.com

broadcasting have emerged, and they are to be adopted in the UK. These standards are known as 720p, 1080i and 1080p.

Like many other TV format names, 720p is actually a short-hand expression that can refer to several video formats but has been adopted to signify only one of them. In fact, 720p can refer to any video that uses 720 horizontal lines and no interlacing. The p stands for progressive scan, the method where every line of each frame is drawn in turn from the top of the screen to the bottom. Progressive scan broadcasts are sometimes said to have a 'film look', as a 25fps progressive TV broadcast is similar in nature to the 24fps progressive system used in cinema.

The 720p video used in HDTV broadcasts uses 720 horizontal lines, and the p denotes that they are progressively scanned – that is, scanned from top to bottom in one pass without interlacing. The 720p formats used in High Definition television have a wide aspect ratio of 16:9, giving a picture resolution of 1,280x720. The 720p broadcasts are common in the US, where High Definition broadcasts are commonly available via cable television. In particular, ESPN-HD and Fox broadcasting transmit sporting events in 720p.

RESOLUTION ROCK

The chief alternative to 720p is 1080i. Like 720p, 1080i can refer to any resolution with 1,080 horizontal lines and interlacing, but it is commonly used to denote 1080i in a 16:9 aspect ratio and a frequency of 50-60Hz. This produces a picture with a resolution of 1,920x1,080. LCD, plasma and DLP televisions must de-interlace a 1080i signal in the same way that they de-interlace older PAL and NTSC broadcasts, and the quality of de-interlacing varies between televisions.



The image resolution of 1080i High Definition TV (full picture) compared to the current PAL I standard (bottom left)



Some argue that 1080i is superior to 720p as it provides a greater number of pixels (1,965,600 to 720p's 921,600), but proponents of 720p claim that the problems associated with de-interlacing outweigh any benefits it has. In the US, 1080i has been adopted by many cable broadcasters, including CSN and NBC.

One other much-discussed standard is 1080p. This uses the same 1,920x1,080 resolution as 1080i, but without any interlacing. Far fewer televisions support 1080p than support 1080i and 720p. In fact, a television marked 'HD Ready' need not support 1080p (for more information on what this badge does guarantee, see the 'What Does HD Ready Mean?' box below). Currently the only 1080p video available is encoded in WMV-HD format. If you have a powerful PC and a high-resolution monitor, you can download samples from the Microsoft website.

Both 720p and 1080i have supporters, and neither is universally accepted as the better choice. In general, broadcasters are likely to pick the format most suitable for each programme. The BBC's High Definition Guide, designed for producers creating High Definition video content, notes that "dramas and documentaries might choose progressive, while sports, concerts and other live shows might benefit from the 'immediacy' of interlace".

HOW IS IT COMPRESSED?

With the exception of Japan's outdated MUSE system, High Definition television is transmitted digitally. The video can be encoded using a number of lossy compression formats (see *How It Works*, *Shopper* December 2005); most US channels and the European channel HD1 use MPEG2 encoding.

Since High Definition television is arriving later in Europe than in America, however, it is possible for European broadcasters to take advantage of more efficient compression to squeeze more channels into the available broadcast frequencies.

Just as popular MPEG4 codecs such as DivX can compress video into smaller spaces than the MPEG2 system used in video DVDs, a type of MPEG4 encoding, sometimes known as H.264 or AVC, can deliver broadcast video in around half the bandwidth required by MPEG2. Sky Television has confirmed that its first HD broadcasts will use MPEG4 encoding.

WHAT CAN I WATCH?

Currently there is only one High Definition television broadcaster in Europe. Euro1080 (www.euro1080.tv) broadcasts in MPEG2. To receive it you need a satellite dish pointed at the



The latest games consoles can display 3D graphics in a High Definition resolution. This example compares a screenshot from a standard NTSC television (left) with one from a 720p screen with anti-aliasing (right)

Astra 1D satellite, an HD-ready satellite set-top box and a conditional access card to decrypt it. Its programming is an eclectic mix of genres; as we went to press, it included a large amount of World Cup handball and some rather more interesting documentary programmes.

In 2006, however, far more High Definition television will arrive in the UK. Most notably, Sky has made a firm commitment to introduce a High Definition service. It will be able to broadcast 1080i and 720p programmes encrypted in MPEG4. The shows available in High Definition will include Premiership football, and the High Definition set-top box required to receive High Definition content will also work as a Sky+ personal video recorder (PVR). Currently the start date for this service, and the cost of upgrading to and receiving such broadcasts, are yet to be announced.

The BBC has a similar commitment to commence High Definition broadcasting in 2006. Some BBC shows are already shot in High Definition formats for export purposes – *Rome* and *Bleak House* are recent examples. The corporation is committed to providing a High Definition version of BBC1's peaktime schedule via High Definition satellite and cable from mid-2006, so it should be available to Sky's High Definition subscribers. The BBC has also announced its intention to run a trial of terrestrial High Definition television in London, but this depends on Ofcom allocating an unused part of the broadcast spectrum for the trial.

Digital cable networks such as those used by NTL and Telewest have the capacity to carry High Definition broadcasting. Telewest's first High Definition trials are scheduled to begin in December

2005. Its TV Drive personal video recorder service uses a set-top box that is capable of receiving High Definition video, and it has announced that it has already secured High Definition programming from the BBC.

NTL has announced that it too will be launching a PVR service, and the set-top box it has chosen is both High Definition and MPEG4-compatible. The similarity between these two cable services is unsurprising given that NTL and Telewest have agreed to merge into one company in the near future.

BEYOND TELEVISION

A High Definition television set has other uses beyond viewing television broadcasts. The next generation of computer game consoles will provide better graphics than ever before, but you will need a High Definition display to make the most of them. Sony has announced that its PlayStation 3 console, which is expected to launch in 2006, will output 1080p video. Microsoft's Xbox 360, which is already available in the UK, supports both 720p and 1080i. Software developer Bungie has announced that its game Halo 2, originally released on the Xbox, will run in 720p with full-screen anti-aliasing on the Xbox 360.

High definition content will also be available via a new generation of DVD disc. Two optical disc standards, Blu-ray and HD-DVD, are currently being proposed and it is unclear which will be more widely adopted, but both standards are designed to store High Definition video encoded in either H.264 MPEG4 or VC-1. The VC-1 codec is based on Microsoft's High Definition WMV format. **CS**

WHAT DOES HD READY MEAN?

Most televisions capable of displaying High Definition video are marked with a distinctive HD Ready logo. This badge is awarded by the European Information and Communications Technology Industry Association (EICTA) to products that fulfil certain criteria.

Any TV marked as HD Ready must be capable of displaying both 720p (1,280x720 at 50 or 60Hz) and 1080i (1,920x1,080 at 50 or 60Hz) signals. It must have a minimum native resolution of 720 horizontal lines. An HD Ready television need not be capable of displaying 1080p, however. Very few of the televisions currently available can display this kind of high resolution, progressively scanned signal: for more information, see our LCD Television Labs test on page 175.

A television marked HD Ready must have a DVI or HDMI digital input that supports HDCP Digital Rights Management (DRM). This makes it simple to connect it to a computer via a DVI cable or a DVI to HDMI converter. It must also accept component video, but it's important to note that it need not have the standard 3-conductor component video connector found on many DVD players. The HD Ready requirements state that component video input must be available through standard connectors "or an adaptor easily accessible to the consumer", so check to make sure that you have the cables you need.

